

## FURNITURE FOR MITIGATING THE EFFECTS OF A DISASTER

### Technical Field

This invention relates generally to furniture and more particularly to furniture to mitigate adverse effects of the furniture or a surrounding structure during a disaster, the disaster 5 being, for example, an explosion, blast, earthquake, hurricane, tornado, etc.

### Background of the Invention

During a disaster, such as an explosion, blast, earthquake, hurricane or tornado, furniture can become a danger to the occupants of buildings. The energy and force of such disasters can move furniture into occupant areas and against occupants therein to create personal 10 injury and in some situations, the energy and force of a disaster may break furniture apart to thereby transform the furniture into shrapnel. During a disaster the surrounding structure of a building may also create a risk to occupants.

As such, it may be desirable to create furniture that to some degree mitigates the harmful effects that furniture or the surrounding structure may cause in a disaster.

### Summary

In accordance with a broad aspect of the present invention, there is provided a piece of furniture comprising a first part including a first outer surface, a second part including a second outer surface, a seam formed at an interface of the first part and the second part, and a polymer coating adhered to the first outer surface and to the second outer surface 20 and extending over the seam.

In accordance with another broad aspect of the invention, there is provided a piece of furniture comprising a work surface including an upper surface and an underside and defining a plane, the work surface supportable at a work level forming a space at the underside of the work surface and a panel positionable in the space at the underside of the work surface, the panel including a curved outer surface and a wall selected to be resistant to passage therethrough of flying debris and a substructure to support the wall.

In accordance with another broad aspect of the present invention, there is provided a piece of furniture comprising a work surface including an upper surface and an item securing system including a retainer engaged to the work surface to releasably secure an office object thereto.

#### Brief Description of the Invention

The furniture of the present invention can be built to mitigate the effects of a disaster and minimize damage and injury to occupants from movement of the furniture or from flying debris or parts resulting from the furniture. Alternately or in addition, the furniture of the present invention may be formed to act as a protective shelter if the surrounding building structure creates a risk to the well being of occupants during a disaster. A disaster can be, for example, an explosion, a blast, an earthquake, a hurricane, a tornado, etc. that creates a short term or longer term force, shock or energy wave.

The invention provides various aspects that may be applied singularly or in various combinations to furniture. The selection of any of the various aspects may be made with consideration as to the form of disaster that is to be addressed, for example, whether it be an earthquake or a blast, and the degree of threat of the possible disaster.

In one aspect, furniture is disclosed that can be securely held in place and/or together. For example, furniture of the present invention can include anchoring mechanisms such that the furniture can be secured to larger structural members such as a floor or wall of a room in which they are placed. Anchors may also be used to secure the parts of a unit and/or 5 separate units together to construct an individual unit or an assembly of individual units. Alternately or in addition, the furniture can include a substructure, which can be, for example, a frame that can be used to reinforce the piece of furniture or to secure individual furniture units together.

In another aspect, the furniture can be formed to reduce its ability to contain blast energy, 10 thereby diverting it or releasing it rather than being adversely acted upon by the blast energy. To reduce the furniture's ability to contain blasts, the furniture can comprise rounded edges and/or vents. To achieve this, curved or rounded forms may be used for example on the edges of the furniture, on legs, and/or on wall panels. The furniture can, alternately or in addition, include actual or formable vents that can help hold the furniture 15 together in shock situations.

Alternately or in addition, an item securing system can be provided such that items or objects associated with furniture units, such as for example computers, computer equipment, telephones or office supplies, can be secured to the furniture using retainers such as locks, latches, catches, netting, braces or any other type of securing apparatus, 20 mechanism, device or technology. Retainers can be firmly secured to the furniture unit so that the secure items can be held against movement during the disaster.

Furthermore, the furniture can include, alone or together with any of the other aspects, non-protruding hardware, such hardware including for example, handles, locks, latches, catches, etc. Alternately or in addition, the furniture of the present invention may include an automatic positive latching system such that drawers and/or doors, which may fly open

5 in a blast, are firmly secured and automatically releasably locked when in a closed position.

It can be useful to eliminate gables and large conventional, usually vertically oriented, flat panels that can be moved or fragmented in shock situations. Instead, open areas, flexible panels and/or panels that can be resistant to flying debris can be used, if desired.

10 In another aspect of the invention, the furniture can contain a locator device that can be manually or automatically set off in the event of a blast, explosion or other disaster. The locator device and its methods for employment can depend on technologies, such as coding or triangulation, and can function to signal the location of an occupant or a position of interest to rescuers.

15 The furniture can be fabricated from or include various materials including those that are heat-, fire-, and/or fragmentation-resistant, those that are resistant to passage therethrough of flying debris (i.e. anti-ballistic) and/or that can withstand the force of a disaster such as a blast without deteriorating in a manner that will cause serious injury or damage. In one embodiment, the furniture, for example along its edges, are formed or fitted with a

20 cushioning material, such as a polymer, to reduce any impact effect.

The furniture of the present invention can include independent units intended to be used separately or in combination or multiple units that can be secured together, as in a modular

concept. The furniture can include that for offices, hotels, schools, residential or other applications.

In spite of all of the technical aspects providing an ability to mitigate the adverse effects of furniture in a disaster, it is useful that the furniture of the present invention has the 5 aesthetic appearance and functionality similar to conventional furniture.

#### Brief Description of the Drawings

The present invention, both as to its organization and manner of operation, may best be understood by reference to the following description, taken in conjunction with the accompanying drawings, wherein like reference numerals are used throughout the several 10 views, and, in which:

Figure 1 is a perspective view of furniture able to mitigate the effects of a blast according to this invention. Only one of many possible configurations is shown.

Figure 2 is a top plan view of the furniture of Figure 1, showing one of many possible configurations of a desk unit.

15 Figure 3 is a bottom plan view of the underside of a plurality of work surface units showing a frame mounted thereon.

Figure 4 is a sectional view through an edge of a desktop useful on furniture according to this invention.

Figure 5A is a perspective view of a desk unit.

20 Figure 5B is a top plan view of the desk unit of Figure 5A.

Figure 6A is a perspective view of a cabinet.

Figure 6B is a perspective view of a lateral cabinet.

Figure 6C is a perspective view of a wardrobe.

Figure 7 is a top view of a desk bridge unit.

5 Figure 8A is a top view of a cage according to this invention.

Figure 8B is a perspective view of the cage of Figure 8A, with inner layer 37a removed.

Figure 8C is a perspective view of another cage.

Figure 8D is a top plan view of the cage of Figure 8C.

Figure 8E is a sectional view through a substructure member useful in a cage of the  
10 present invention.

Figure 9 is a perspective view of a desk with overhead unit of the present invention.

FIGS. 10A and 10B are perspective views of a stackable lateral cabinet according to this  
invention.

Figure 11A is a top view of a possible configuration of a modesty panel, which may lead  
15 to the force of the blast being caught by furniture.

Figure 11B is a top view of a possible configuration of a modesty panel according to this  
invention to deflect the force of a blast.

#### Description of Various Embodiments

Some of the many possible embodiments of furniture pieces of the present invention are illustrated in a perspective view in Figure 1. While an office arrangement is shown, it will be appreciated that the principles disclosed herein can be applied to furniture for other uses such as bedrooms, eating areas, classrooms, hotel rooms, etc. In Figure 1 a typical 5 layout of furniture is shown, but it is to be understood that other layouts can be used. Furthermore, although furniture of example dimensions is shown, it is to be understood that dimensions and other features can be modified.

Furniture of the illustrated embodiments includes work surface units, storage units and combinations thereof. For example, illustrated work surface units include, for example, a 10 desk unit 2, a bridge unit 3 and a desk return unit 4. Work surface units may include a work surface such as desktops 25, 30 or 39, each including an upper surface and an underside. The work surface may be, as will be appreciated, generally planar defining a plane. The work surface may be supportable at a work level forming a space at the underside of the work surface. The work surface can be supported in various ways, as by 15 one or more legs 19, as shown, or one or more pedestals, support frames, mounting brackets, panels, support drawers, etc. The work surface may be generally horizontal or may be tilted or tiltable, as would be useful in, for example, a drafting table.

Illustrated storage units include, for example, an overhead cabinet 40, a wardrobe 5, a filing cabinet 6 and a lateral cabinet 7. A storage unit may include at least one outer wall 20 24, 24a, an inner space 50 (Figure 6C) defined by the at least one outer wall, an opening 52 through the outer wall to access the inner space and a closure panel, such as a door 42 or drawer front 27, in the opening that is openable to access the inner space.

As noted previously, the various aspects of the invention can be applied alone or in combination to furniture units to mitigate adverse effects by the furniture or the surrounding structure of a building during a disaster. Various aspects of the invention may be applied as is desired depending on, for example, the degree and nature of the disaster  
5 threat.

In energy shock situations, furniture has been known to blow apart. To help mitigate this occurrence, unitized construction can be used to assemble the parts of individual units and to assemble a plurality of units. In one embodiment, for example, the parts of individual units such as adjacent wall panels, legs to a desktop, etc. may be secured together using  
10 fasteners 43 (Figure 4) engaged in durable threaded inserts 44, such as of metal or durable polymers, installed in the material of the parts. Such inserts may be installed to engage threaded fasteners, such that threaded engagement can be improved over that of a fastener directly into a wooden component. A fastening system including a metal-fasteners-to-metal-inserts arrangement throughout has been found to be useful. Washers 46 can also be  
15 used to reinforce fasteners 43, to further enhance engagement between the parts of the unit.

Alternately or in addition, furniture units can be coated with a polymer coating 48 that can be applied over at least some seams 47, such as joints, interfaces and gaps between parts in the assembled unit or assembled units to help hold the components together. In one  
20 embodiment, a polymer coating is applied and adhered to furniture surfaces to coat at least a portion of the furniture surfaces and to extend over at least some of the seam area between components. Seams/joints can, for example, be those between side, top and/or rear panels of cabinetry, between horizontal members (for example a desktop) and vertical

members (for example legs 19 or leg fastening plates 22 or frame 8), between the work surface and work surface mounted components (for example uprights such as support columns 55), etc. In order to hold furniture unit parts together, a polymer may be particularly useful that exhibits some elastomeric properties, rather than being overly 5 brittle. For example, although not meant to be limiting, some possible polymer coatings may include urethanes and/or ureas, such as polyurethane, polyureas or blends thereof. If desired, various surfaces may be left uncoated. Such surfaces may include unitary surface areas, such as leg and desktop surfaces. The coating may be applied over inner and/or outer surfaces can be coated for fragmentation resistance. Coating of inner surfaces (i.e. 10 defining storage areas in a cabinet) has been found to counteract the reflective pressures that may occur in enclosed areas. Coating substantially continuously over outer surfaces may enhance visual uniformity, for aesthetic purposes. In addition or alternately, the polymer coating may be colored to also act as paint. Polymer coating may be applied using various methods including dipping, spraying, brushing, etc. Polymer coating 48 15 may also serve other purposes as will be described herein below.

In another embodiment, as shown in Figure 2, a frame 8 can be used to provide structural integrity and reinforcement in an individual unit or between units. In the illustrated embodiment, frame 8 acts to secure desk unit 2, bridge unit 3 and desk return unit 4 together. Frame 8 can be formed of materials that can resist fragmentation in a shock 20 situation such as steel, such as rod, bar, or tube forms, or durable polymerics such as for example, fiber reinforced polymers including fiberglass. In one embodiment of this invention, frame 8 can be made of steel and can include a number of members that can be fastened together using a variety of different methods such as molding, welding, etc.

Figure 3 illustrates one of the many possible configurations for a frame and includes a main panel reinforcing connector bar 9 connected to the underside of a plurality of furniture units and extending continuously across a panel of at least one furniture unit. Frame 8 may further include auxiliary connector bars 10, 12 also connected to the 5 underside of a plurality of furniture units and cross members 11, 13 and 14, extending between the connector bars. Frame 8 can be installed using a variety of devices or methods including the use of fasteners 43, anchors, etc. as for example described hereinbefore.

In addition to reinforcing a piece of furniture or securing individual furniture pieces 10 together, frame 8 can serve other various functions such as providing a reinforcing cage to support a panel, such as desktop 30, such that the panel can withstand a cave-in substantially without fracturing. Frame 8 and desktop 30 thereby form a protected space therebelow for an occupant during a cave-in. Alternately or in addition, frame 8 can act as 15 an anchor to secure item securing systems, such as to secure computer equipment, or to secure other furniture components such as an under-desk panel, for example, a modesty panel 23 or a cage 31, both of which will be described in greater detail hereinbelow.

Frame 8 can also include a helmet hanger 15, such as, for example, a hook, a magnet, a hook and loop fastener or a strap, and one possible embodiment is illustrated in Figure 3. 20 Helmet hanger 15 can be used to conveniently hang, out of sight below a desktop, a helmet that can be quickly retrieved by an occupant in case of a disaster.

It is useful to take measures to hold the furniture against easily moving around during a disaster. The furniture of the present invention may therefore include anchors for

anchoring the units to the surrounding structure, such as a wall or floor. For example, furniture legs 19 can be secured, using various approaches such as screws, bolts, pins, floor embedded channels, retainers, etc. to an existing floor 20 or wall of the room in which the furniture is used. The anchors can be secured to the floor in various ways. For 5 example, the anchors can be imbedded or inserted, for example by drilling or driving, into the floor. FIGS. 1 and 2 show one possible embodiment wherein furniture unit legs 19 are secured to anchor plates 21, which are mountable to existing floor 20 structures using fasteners 58 engagable through apertures formed through the plate and securable in the floor. Fasteners 58 may be formed of durable materials such as steel, for example, 10 including stainless steel.

In another aspect, furniture of the present invention may include substantially rounded curved surfaces, such as panel or desktop edges, as indicated at 16 in Figure 4, outer facing surfaces 19a on the legs, some cabinet walls, as indicated on wall 54 of cabinet 6, and/or under-desk panel members, such as modesty panel 23 or protective cage 31. 15 Substantially rounded, curved surfaces can be useful for reducing the possibility of the force of a blast shock being captured by the furniture unit, such that the force of the blast is deflected to minimize damage to furniture and to minimize impact injury to and create a shield for an occupant adjacent the furniture. In some embodiments, it may be useful to position the furniture unit with its rounded surface facing away from an occupant area. 20 Polymer coating 48, as described above, can also help eliminate any gaps, seams, or spaces between components that may catch the effects of a blast. As noted above, seams can, for example, be those between side, rear and top panels of cabinetry, between horizontal and vertical members, between a surface and surface mounted components, etc.

The characteristics of polymer coating 48 may be selected depending on the purpose it is intended to serve. For example, if polymer coating 48 is intended to be used to fill gaps to reduce areas that catch the effects of a blast, then it may not need to exhibit elastomeric properties. Also, the thickness of the coating may be selected depending on the intended 5 purpose of the polymer coating. For example, where the coating is applied only to mask gaps, it may be applied in a thinner layer than if the coating is intended to hold furniture parts together. In one embodiment, a coating intended to resist fragmentation of furniture parts may be applied in a coating of 1/32" (0.5mm) or more and in another embodiment a coating thickness of 1/8" (3mm) may be used. A coating intended to span gaps for 10 reducing the blast catching properties may have a thinner application than that, if desired.

Furniture can be constructed entirely or in part of a material that is fragmentation-, fire- and/or heat-resistant such as steel, aluminum or other metals, a polymer such as, for example, urethanes, ureas or polyvinyl chloride (PVC) or fiberboard coated with a polymer. Polymers with elastomeric qualities can also be used to provide cushioning for 15 impact reduction. Cushioning polymers may for example be particularly useful for edging materials or vertical panels that are more easily moved in a blast situation. In one embodiment of this invention, a construction material can include of a medium density fiberboard (MDF) core 17 that has polymer coating 18, for example of urethane. The presence of coating 18 can serve several different functions such as providing fire, heat 20 and fragmentation resistance to coated pieces and some cushioning. Coating 18 and coating 48 can each be used alone or in combination.

In one embodiment of this invention, aluminum extrusions can be used for legs, support columns, uprights, cabinet frames, etc. Aluminum exhibits good flex with significant

materials strength. Interfitting elongate extrusions may be useful for forming elongate forms with an axially sectioned construction, since such forms have been found to enhance the flexibility of a part by sliding movement between the axially extending sections. In one embodiment, for example, elongate aluminum forms such as legs 19 may be formed of a first elongate extrusion forming an outer surface 19a, which is curved in this embodiment, and a back cap extrusion 19b, that covers the open channel of the first extrusion. Other materials of use may be anti-ballistic materials such as a sheet material of, for example, polyaramid, carbon fiber, nanotube, etc.

In a disaster where an energy shock wave is generated, injury can occur by objects caught up in the energy shock wave. Sometimes those items can be simply furniture doors and drawers that are rapidly opened by the force of the shock wave. Thus, in one embodiment of the invention, an automatic positive latching system 60a – 60c may be provided for use with furniture storage area closures such as doors, for example door 42, drawers 28, drawer trays, etc. An automatic positive latching system provides that a storage area closure, once closed, automatically and positively locks in the closed position, but can be unlocked to permit storage area closure to be opened. An automatic positive latching system may include a catch 60a that automatically locks against a stop 60b and a release actuator 60c operable to release the catch from its locked position against stop 60b. In one embodiment, the catch can be, for example, spring biased, and release actuation can be operated by, for example, by a button or handle to overcome the biasing force of the spring.

Other injuries have been known to occur when common smaller office equipment is carried by the shock energy. Thus, in yet another embodiment, the furniture can include

or support an item securing system that is attachable to the furniture unit and can include a wide array of various locks, catches, straps, netting or latches or other locking or clamping mechanisms. The securing system can be used to secure smaller office equipment such as telephones, computers, keyboards, computer monitors or other equipment to the furniture 5 unit, for example onto a desktop, such that this equipment is prevented from moving in a shock situation and causing serious injury to an occupant.

Various embodiments of work surface units will now be described in greater detail. As shown in FIGS. 1, 2 and 5, and 7 to 9 work surface units such as desk unit 2, bridge unit 3 and desk return unit 4 can each include a desktop as a work surface. In units 2 and 4, the 10 desktops 25 and 39, respectively, are each supported at a work level above a floor by plurality of legs 19. Desk unit 2 can be anchored to existing floor 20 through anchors 21 which are secured to legs 19. Legs 19 are then secured to desk unit desktop 25 through fastening plates 22. In one embodiment, lock washers can also be used to reinforce fasteners. Legs 19 can also be secured to the underside of desktop, such as of desk unit 2 15 and desk return unit 4, using fastening plates 22, as shown in Figure 2. The fastening plates can be made out of a variety of different materials such as steel. The legs can be fastened with fastening plates to the underside of desks using various fastening approaches. In one embodiment, washers can also be used to reinforce fasteners.

Bridge unit 3 is supported at a work level by frame 8 connected to integrate desk unit 2, 20 bridge unit 3 and desk return unit 4.

To mitigate the adverse effects of a disaster, it may be useful to reduce, as much as possible, vertical flat surfaces that may act to capture, rather than deflect the shock of a

blast, many large panels have been removed from the furniture units of the present invention. However, it may remain desirable to provide a panel for installation in usually a substantially vertical position below the desktop of a work surface unit for modesty/privacy purposes. Thus in one embodiment, a modified blast-resistant under-5 desktop panel may be provided. Under-desktop panels may have generally rounded, curved shapes that tend not to contain a blast but rather work to deflect debris and shock about the furniture to protect an occupant area positioned therebehind. The panel can be curved in a horizontal direction from side to side such that force deflection occurs around the two sides of the panel. The panel may also be formed of blast dampening or resistant 10 materials. Because the under-desktop panel may provide an element of occupant protection, a panel may be useful even where modesty/privacy is not an issue. Two of the many possible forms of under-desktop panels are shown including a modesty panel 23 and a cage 31.

Modesty panel 23 can serve to protect the legs of an occupant and can be located beneath a 15 desktop surface to span substantially between the floor and the desktop in a position to act in the same way as other conventional modesty panels. The panel can be positioned between the floor and the desktop surface. Modesty panel 23 may be light-weight or more substantial and can include substructure that does not easily fragment in a shock situation for example of a fiberboard (i.e. cardboard), a foam, a foam-fill and/or a steel or polymeric 20 frame. The substructure may be covered with a sheet material or paint for aesthetic purposes. Alternately, the covering may be selected for blast- or fire-resistance or its anti-ballistic properties. One covering that may be used includes at least one of a polyaramid, carbon fiber, nanotube, (Nomex™ or Kevlar™), etc. construction.

Modesty panel 23 can act as a blast curtain or cushion in a shock situation and can protect the legs of an occupant of the unit. The outwardly curved (convex) side can be positioned facing away from the occupant and horizontally-curved shape of modesty panel 23 can deflect the force of a blast, thereby protecting an occupant area from flying debris. If 5 modesty panel is foam filled or includes flexible portions and the force of a blast pushes modesty panel 23 onto the legs of an occupant, its lightweight soft core should result in little or no injury and may even act as a shield to protect the occupant from flying debris. To prevent the panel from being knocked over, the panel can be secured to the desk by straps or other loose securing means.

10 Where the modesty panel includes a frame or rigid substructure, the frame may be secured between the desktop and the floor, such that it doesn't move. In such an embodiment, it may be useful to position a covering on the side of the frame facing away from the occupant. Thus, in the event of a blast, the covering may be driven against the frame and supported thereby. The covering can be secured to the frame in various ways with 15 consideration as to the force it may be required to withstand.

Another under-desktop panel may be formed as a protection cage 31, as shown in Figures 1, 2, 8A and 8B. Protective cage 31 can be used by an occupant as a shelter during a disaster such as a blast or explosion, and alone, or together with the desktop, etc., can provide a shelter or support against cave-ins creating a void where an occupant can await 20 rescue. Cage 31 can serve as a shelter for an occupant during a blast and may provide a protective area supported against the collapse of a surrounding structure. As such, cage 31 can be selected to provide a desired resistance against vertical crushing of its structure. In one embodiment of this invention, cage 31 can include a frame that includes at least some

rods 36 that act against vertical compression. In another embodiment, cage 31 can also comprise secondary rods 36a that create a triangulated frame construction or can extend diagonally between vertical rods 36. The rods of the frame can be constructed from materials with significant axial strength in compression and with resistance to fragmentation, for example steel or structural polymerics, which may, for example, include fiber reinforcements.

Again, forming the cage in a curved manner provides for deflection of the blast and the cage can be positioned to divert the force of a blast away from an occupant area. Cage 31 may also be formed to shield an occupant area against shrapnel and/or the force of a blast.

10 For example, the rods can be selected to be resistant to breaking under lateral loads and a wall can be supported between and/or about rods 36, 36a. Sheet materials 37 secured to the rods can form the wall. Sheet materials 37 may be formed of metal, flexible materials including polyaramid, carbon fiber and/or nanotubes, etc. that have anti-ballistic and/or shock-, fire- or blast- resistant capabilities. Other materials such as cushioning layer 37a of foam, foam-fill or fabric can also be used. The sheet materials can be fastened to rods 36, 36a using fasteners 43 or other fastening technologies. In one embodiment, reinforcements such as washers 46 can be used about the fasteners. The cage can also be positioned to act as a modesty panel, as was described hereinbefore, or whenever there is a desire to protect an occupant area.

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20 Cage 31 can be integrated to a frame 8 and/or to a floor to increase its strength, if desired. For example, in the illustrated embodiment, frame 8 and desktop 30 create a roof for cage 31 and firm engagement can be formed between rods 36 of the cage and frame 8 to act against lateral movement of the cage relative to the desktop/frame.

In another embodiment of this invention, cage 31 can also include a locator 38, as shown in Figure 1, to aid in the rescue of occupants in the event of a disaster. Locator 38 may be automatically or manually set off to create a positional signal, such as a radio or audible signal during a blast or explosion. Many locator transponder technologies will be apparent to the skilled workman. In another embodiment, cage can also or alternately include survival or first aid kit including, for example, any of survival instructions, first aid equipment, a flashlight, bottled water or nutrition bars.

Another cage 70 is illustrated in Figures 8C to 8E. Cage 70 can include a frame formed of rods 36b that act against vertical compression and lateral bending and upper and lower webs 36c that connect between and hold rods 36b in a stabilized vertical orientation. Upper and lower return flanges 36d provide anchor points for installation between a floor and the underside of a work surface. Apertures 72 can be spaced along flanges 36d through which fasteners may be installed.

The frame components of the cage can be formed from steel or other durable materials. In one embodiment, rods 36b of the frame can be constructed from a multi-walled tube arrangement wherein a first tube 74 is installed in an outer tube 76. If desired, a shock absorbing, stabilizing filler material, such as sand 78, cement or other materials, may be introduced to fill the space within and about inner tube. This provides a tube with considerable significant strength in compression and against lateral bending and with resistance to fragmentation. Forming upper and lower webs 36c and upper and lower return flanges 36d of at least 1/8" (3mm) or 1/4" (6) steel plate further strengthens the cage form.

Again, forming the cage with an outer surface 80 that is curved from side to side provides for deflection of a blast so that the cage can be positioned to divert the force of a blast around an occupant area.

Cage 70 may also be formed to shield an occupant area against shrapnel and/or the force 5 of a blast by providing a wall 82 formed of sheet metal. If enhanced anti-ballistic properties were required, further sheet materials 37 for example including polyaramid, carbon fiber and/or nanotube technologies may be layered on top of or behind the metal wall. Of course, other materials such as a cushioning layer or decorative outer layer may be used.

10 Cage 70 can be integrated to a frame 8 and/or to a floor to increase its strength, if desired. For example, frame 8 and desktop 30 can create a roof for cage 70 and firm engagement, as by fasteners 43, can be formed between upper flange member 36d and frame 8.

In the illustrated embodiment, a further top plate 86 may be added to create a roof for the cage. Gussets 88 can be secured between top plate 86 and rods 36b to support the plate. 15 Of course, although shown in the illustrated embodiment, a cage need not include both a top plate and a upper return 36d, if it is desired to reduce materials.

In one embodiment, under-desktop panels can be positioned in such a way as to direct the force away from moveable components or components such as furniture doors, drawers, etc., that, if caught up in the blast, may cause injury to an occupant. As illustrated in 20 Figure 11A, and using modesty panel 23 as an example, the panel can be spaced in front of or in line with the location of drawers fronts 27. In such a position, the force of a blast, shown as arrow F<sub>1</sub>, may catch drawers 28 and pull them out into the occupant area, which

may cause damage and injury. In another position, which is not meant to be limiting and is illustrated in Figure 11B, modesty panel 23 can be offset from lateral cabinet 7 in such a way that an outer side edge of the modesty panel overlaps, when viewed from the side, with the location of drawer fronts 27 to prevent drawers 28 from catching the force of a 5 blast shown as arrow F<sub>2</sub> and from being pulled out into the occupant area. Fasteners, such as welding, bolts, screws, straps, etc. may be used to secure the under-desktop panels in a selected position.

Work surface units can include drawers and trays, as will be appreciated, for storage of office supplies, computer input devices, etc. For example, in the illustrated embodiment 10 desk unit desktop 25 includes a tray 27 that can be used to hold a plurality of items such as pens and pencils or other supplies. Tray 27 can be secured to the underside of a desktop, such as desktop 25 or another desktop and can be pulled out by an occupant. As another example, a key board tray 39 may be mounted under a desktop, for example to the underside of bridge unit desktop 30. Trays and drawers can take various forms including 15 single level arrangements or full or partial banks and can be secured or positioned at the underside of a desktop using various configurations. Trays and drawers can, if desired, include a positive locking system that automatically locks a drawer upon closing of same and can be released to open the drawer.

The desktops 25, 30, 39 of work surface units can have substantially rounded and 20 cushioned edges to help deflect the force of a blast and protect an occupant. The corners of the desktops can also be substantially rounded to diminish the risk of injury and damage during a disaster such as a blast.

An item securing system is illustrated in Figures 1, 2 and 7. While the item securing system is shown on bridge unit desktop 30, it is to be understood that it, if desired, could be installed on any supporting surface such as a work surface, a drawer tray or a shelf. An item securing system may include a plurality of retainers firmly secured to the furniture unit. Retainers may include, for example, clamps, straps, netting, etc. and may be secured by fasteners, looping engagement, etc. In the illustrated embodiment, the item securing system includes slots 32, 33 to accept retainers and to permit the retainers to be mounted below the desktop such that the desktop need not be marred and, for example, in the illustrated embodiment, such that securing of the retainers may be through the frame, rather than relying only on the weaker material of the desktop itself. Slots 32 permit installation therethrough of straps 62 or netting for anchoring to secure desktop items 61 such as a computer monitor or keyboard, a telephone, etc. Straps 62 or netting that can be inserted through slots 32 for anchoring therebelow. Straps and/or netting can be made of nylon or other similar materials that cannot be easily cut or broken. As shown in Figure 2, the slots 32 can be positioned adjacent frame 8 components to provide an accessible anchor point or reinforcement for the straps or netting inserted into slots 32.

Clamp slots 33 can be used to insert a clamp 34. The clamp can be made of a variety of materials that can resist fragmentation in a shock situation such as steel, polymeric or reinforced polymeric such as fiberglass. Clamp 34 can be used to secure an object such as a portable computer to a desktop, such as bridge unit desktop 30. Clamp 34 can take various forms and may include a base that installs through one of the slots 33 and is secured at the underside of the desktop on which the slot is formed.

Of course, although not shown, slots 32 or 33 could be formed in other ways and could be formed on other desktops such as desktops 25 or 39, if desired, and retainers other than straps and clamps can be used.

Pieces of furniture according to the present invention may also provide for storage. To 5 minimize the risk of injury to an occupant during a disaster, storage units can be substantially free of any protruding handles or other hardware that protrude from their outer surfaces. Storage units can alternately or in addition, include vents that permit pressure equalization in their enclosed areas, thereby preventing implosion or explosion from a sudden pressure change, occurring during a blast or explosion.

10 The storage units can take various forms, sizes and configurations including for example, with reference to Figures 1, 2, 6, 9 and 10, those of a wardrobe 5, an under-desk filing cabinet 6, an overhead cabinet 40, a lateral cabinet 7, a stackable lateral cabinet 41 and many others. Storage units can include openings, as in opening 52, through which access is achieved to inner spaces defined within the outer wall panels, as in panel 24, upper and 15 lower panels 24a, 24b, and rear panels, as in panel 54. The openings may be closable by doors 42 or drawer fronts 27 or may remain open. A storage unit may include a shelf, as in shelf 43, and other structures, as desired and as will be appreciated.

As discussed hereinbefore, disaster mitigating properties may be obtained by providing rounded or curved surfaces to deflect, rather than catch, the force of a blast. Thus, the 20 corners of some cabinets may be rounded, as by use of a corner frame component 69 with rounded front portions 70. As will be appreciated, corner frame component 69 can be used in cabinet construction and can include channels to accept and retain wall panels 24d.

If desired, corner frame component 69 can be formed as an aluminum extrusion in a form similar or identical to legs 19 and columns 55.

In one embodiment, wall panels on a cabinet may also be curved to deflect the force of a blast. For example, with reference to cabinet 6 back wall panel 54 can be formed 5 arcuately from side to side, or in other words curved in a direction substantially perpendicular to an axis X passing through top and bottom panels 24b, 24c of the cabinet. This curved panel 54 provides a surface to be faced away from an occupant area to help in deflecting the effects of a blast from accessing the occupant area.

The panels of enclosed areas, such as, side panels 24, 24a, doors 42 and/or drawer fronts 10 27 can contain vents 26 that can act to prevent adverse pressure differentials from developing in enclosed areas in the event of a disaster such as a blast. In one embodiment, slots 26 can take the form of elongate slots. However, the slots can take many different forms such as holes, meshed areas, pop out plugs, weakened areas, etc. Shelves 43 or partitions can also comprise vents to reduce the effect of pressure thereon. For example, 15 shelf 43 of wardrobe 5 is shown including a pop-out plug 26a, which under a pressure differential condition may open to form a vent.

Handles 29 of storage units can be selected to be substantially flush mount such that they do not protrude significantly from the outer surface of the cabinet and cause injury to an occupant in the event they hit an occupant during a disaster. Handles 29 may be formed as 20 finger catch areas on the planar surface, as in handle 60c on wardrobe 5, or along the edges of doors 42 and drawers 28, as shown by handles 29, which are formed as finger

catch ledges along the edges of the closure panels. In one embodiment, vents can be formed and positioned to act as handles.

To prevent the drawers from flying open in the event of a blast, the cabinet doors and drawers can be fitted with a positive locking system as described above with respect to 5 system 60a to 60c. This permits a closure panel once closed to automatically latch and to require unlatching to be opened. The release portion of the automatic positive latching system may be integrated to the handle as shown at 60c on wardrobe 5 in Figure 1.

Storage units may be installed in various ways. The bottom panels or legs of stackable lateral cabinets can be anchored to the floor or side or back panels can be anchored to a 10 wall to provide greater stability. Stackable lateral cabinet 41 can be stacked as in Figure 10B to any desired height and configuration.

While the invention has been described with respect to the disclosed embodiments, it will be understood that the invention is not intended to be limited to these embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, 15 which may be included within the spirit and scope of the invention. Various modifications will remain readily apparent to those skilled in the art, since the generic principles of the present invention have been defined herein specifically to describe furniture developed to be able to mitigate the effects of a blast.